

# Bureau of Water

South Carolina Department of Health and Environmental Control

## Quality Assurance Project Plan

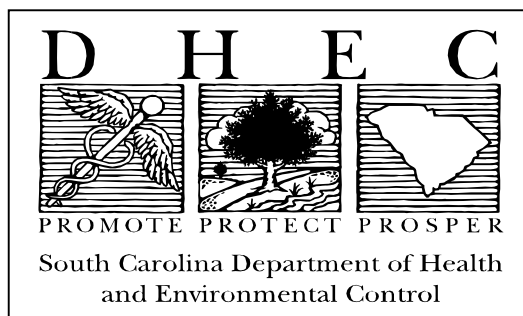
### Sampling and Analysis for S.C. BEACH Monitoring Program

Prepared for the United States  
Environmental Protection Agency  
Region IV Atlanta, Georgia



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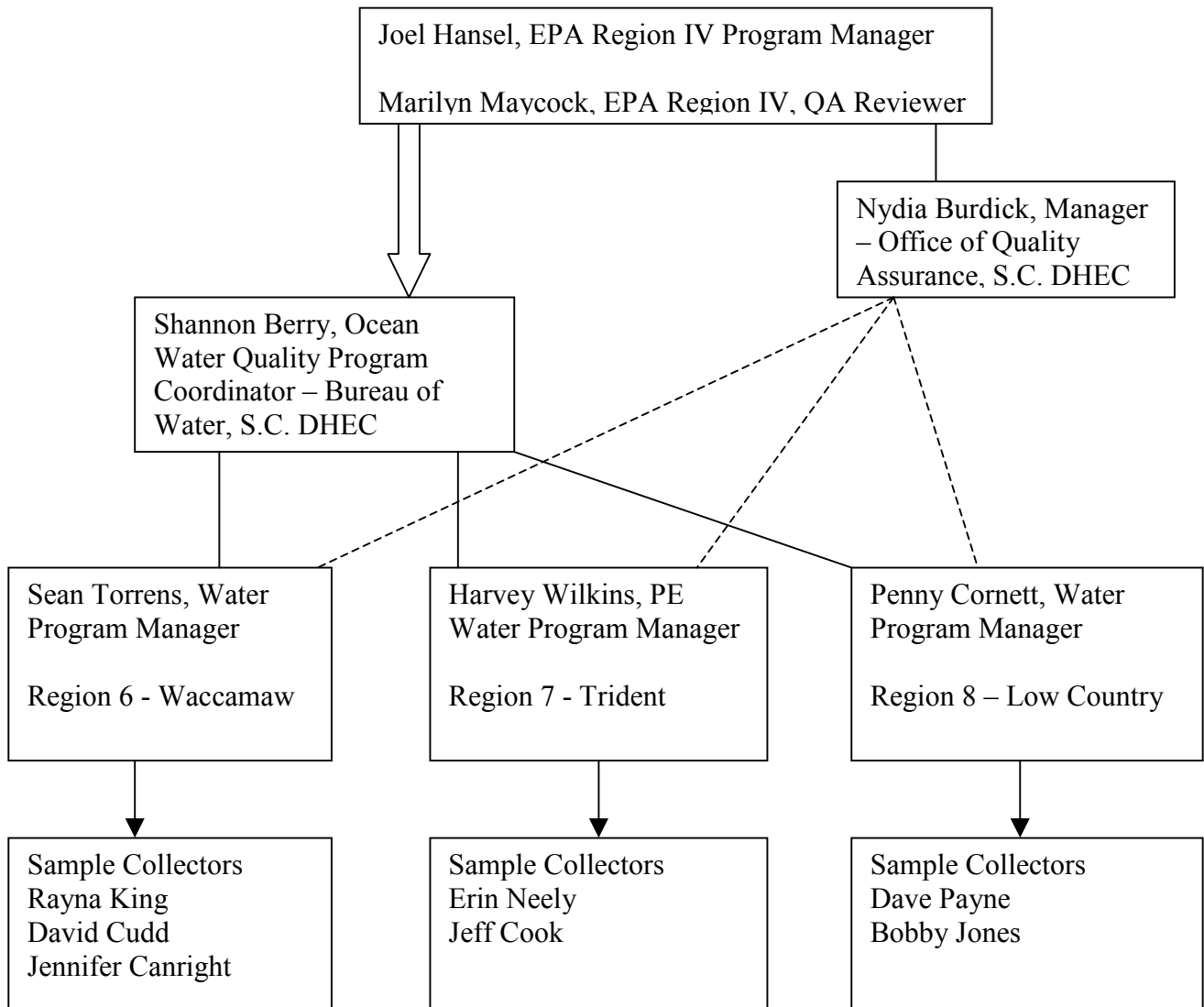
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## Project Organization



The responsibilities of participants are as follows:

*Manager of Office of Quality Assurance*

The Manager of Office of Quality Assurance is responsible for the oversight of all quality assurance activities associated with DHEC sampling and analysis SOPs. The QA Manager reports directly to upper management. The QA Manager will resolve any issues when corrective actions are needed to address data quality issues involving DHEC staff and SOPs.

*Program Coordinator*

The Program Coordinator is responsible for oversight of the South Carolina Beach Monitoring Program. This includes ensuring consistency between region offices and resolving any discrepancies in the sampling and notification programs. The Program Coordinator is also responsible for overall data management and reporting to EPA. The Program Coordinator reports directly to Central Office management.

*Program Manager – Region Offices*

Each Program manager is responsible for local oversight of the monitoring and notification program. Program Managers interpret collected data to determine advisory status. Program Managers report to Region Office management.

*Laboratory Manager – Region Offices*

Each Laboratory Manager is responsible for overseeing day-to-day operations of the region laboratory and assuring compliance with applicable Quality Control procedures. Laboratory Managers report directly to Region Officer management.

### *Microbiologist*

Microbiologists are responsible for analysis of samples and documentation of results following all applicable standard operating procedures. Microbiologists are also responsible for general laboratory maintenance to include instrument calibration. Microbiologists report to Region Office management.

### *Sample Collector*

Sample Collectors are responsible for proper collection and transport of water samples following all applicable standard operating procedures. Sample collectors report to the Region Office Program Manager.

## **Project Management**

### **Background**

During the summer of 1996 there was increased interest by the Department of Health and Environmental Control (DHEC) in the water quality of South Carolina's ocean beaches, especially in the Grand Strand area. A report by the Natural Resources Defense Council and articles in local newspapers sparked criticism because South Carolina did not have a program in place to monitor our ocean water quality and advise swimmers appropriately.

In response to this interest DHEC, in conjunction with several local governments, conducted a study in 1997 to determine levels of bacteria in the ocean water of South Carolina beaches under varying site and environmental conditions. DHEC used this data and experience to develop a model sampling plan. However, due to the logistics of sampling, holding times for samples, laboratory space, and funding, DHEC could not carry out the model plan.

In 1998, the South Carolina General Assembly allocated some non-recurring funds to DHEC for ocean water quality monitoring. These funds were used to carry out the sampling plan established by the 1997 study. This monitoring plan has been carried out each year to present.

This document is a plan to implement a federally standardized sampling, analysis, and notification program. This project builds upon the existing beach monitoring program, fully developing an effective and comprehensive monitoring and public notification plan for South Carolina's coastal beaches and complying with the federal BEACH Program requirements.

### **Project Description and Schedule**

DHEC monitors beach water quality in order to issue beach advisories protective of public health. Bathing beaches and related sampling sites were determined following EPA guidance (Appendix B) and all sample sites have been recorded with Global Positioning Systems (GPS) units. Advisories are issued based on enterococci counts as determined by the Enterolert Quanti-Tray method.

Sampling and analysis is carried out by each coastal Environmental Quality Control Region office: EQC Region 6, Myrtle Beach (Horry and Georgetown county); EQC Region 7, Charleston (Berkeley, Charleston, and Dorchester county); and EQC Region 8, Beaufort (Beaufort, Colleton, and Jasper county). Sampling and analysis may also be performed by the



municipality in which the beach is located, in conjunction with DHEC. All laboratory analysis will be performed by laboratories certified by SC DHEC's Office of Environmental Laboratory Certification. Each coastal region office is equipped with needed supplies for monitoring and sample analysis. A listing of DHEC lab equipment and supplies utilized for the project are stated in each standard operating procedure (SOP). Routine sampling will be conducted April through October at a frequency determined by beach ranking (Appendix B).

Completed Ocean Water Quality Sampling Data Forms (DHEC 2508, Appendix F) will be sent to the Central Office with a copy retained in the region. Testing results and advisories will be stored in DHEC's Environmental Facility Information System (EFIS). DHEC will make data available on a Network Node for upload or retrieval by EPA (Appendix C).

## **Data Quality Objectives and Criteria for Measurement Data**

### Specifying Data Quality Objectives

The purpose of the beach monitoring program is to protect the health of South Carolina's residents and tourists by issuance of advisories based on rapid and accurate measurements of water quality indicators. Advisories will be based on exceedance of enterococci water quality criteria established by EPA in "Ambient Water Quality Criteria for Bacteria-1986." Objectives of the beach water quality monitoring program include:

1. Increasing public awareness of the beach advisory program.
2. Identifying short-term increases in the pathogen indicator, enterococci, for use in issuance of advisories.
3. Identifying trends in bacteriological water quality to aid in development of a predictive model.
4. Continuing documentation of the existing condition of South Carolina's coastal recreational waters.

### Identify the Decision

The steps to the decision making process are identified in the attached flow chart (Appendix D). The goal of the decision making process is to determine if a beach water advisory should be issued. This determination is based on water quality criteria established by

EPA and DHEC. If sample results exceed water quality criteria, personnel will either resample or immediately issue an advisory. This decision is based on the level of enterococci present in the sample ( $\geq 104/100\text{mL}$  = resample (Tier 1&2 only);  $\geq 500/100\text{mL}$  = advise immediately). If resample levels exceed the action level ( $104/100\text{mL}$ ), an advisory will immediately be issued. DHEC will notify local government officials and the public of all advisories.

#### Inputs to the Decision

Data collected for the beach monitoring program include enterococci counts, weather, tidal state, wind current direction, and previous 24-hour rainfall amount. Enterococci counts are the determining factor for issuing advisories. The criteria used to evaluate risk is based on EPA's risk evaluation of 19 illnesses per 1000 swimmers as described in "Ambient Water Quality Criteria-1986."

#### Boundaries of the Study

The monitoring program's spatial and temporal boundaries are described in the "Sampling Design and Monitoring Implementation Plan" (Appendix B). Beaches are ranked by a three tier system according to potential public health risk (i.e., historical water quality data, presence of pollution sources) and beach use. Practical constraints to the program include limited staffing and limited funding and holding time for the sample.

#### Decision Rule

After the collection of marine water samples from bathing beaches using the sample collection protocols described in Measurements / Data Acquisition Section, each sample is analyzed for enterococci. The results for enterococci are reported as a single sample maximum and, where applicable, a geometric mean.

In order to allow time for resampling, routine samples are collected Monday through Wednesday. If a routine sample exceeds the  $104/100\text{ mL}$  action level, a repeat sample must be collected within 24 hours of notification of sample results (Tier 1&2 only). If the repeat sample also exceeds  $104/100\text{mL}$ , an advisory is issued. If any single routine sample exceeds  $500/100\text{mL}$ , an advisory is immediately issued.

Advisories are promptly forwarded by the region's beach monitoring program manager to each coastal EQC Region Office, Central Office personnel, and local government officials, as discussed in the "Overall Notification and Risk Communication Plan" (Appendix E). Media

outlets (i.e., newspapers, local television and radio stations, etc.) are contacted by either the region program manager or the local government, as negotiated. Beach advisories are also posted on Earth 911's Beach Water Quality website ([www.earth911.org](http://www.earth911.org)). Advisories are lifted upon confirmation of sample results below the action level (104/100mL for Tier 1 & 2); no advisories are posted on Tier 3 beaches.

#### Tolerable Limits on Decision Errors

Quality objectives and criteria describe how a sample should be collected and analyzed to ensure that the data are acceptable and usable. False positive and false negative results are avoided by following the prescribed EPA techniques for sampling and laboratory analysis.

Sampling design error occurs when the sampling design cannot capture the extent of variability that exists in the environment and measurement error is associated with bias and imprecision in sampling methodology (sample handling, storage, preservation, and identification). These errors are avoided by collecting samples that best represent the conditions of each area, and by using trained, professional staff that adhere to the QAPP and the standard operating procedures (SOPs), and review data entry. Sampling design and SOPs are discussed in the Measurements / Data Acquisition Section..

#### Specifying Measurement Performance Criteria

Performance criteria (Data Quality Indicators-DQIs) include measures of precision, accuracy, representativeness, completeness, and comparability. Precision and accuracy of samples are determined by laboratory measurements. These factors are addressed in the laboratory QA manuals certified by DHEC, as required by Regulation 61-81, State Environmental Laboratory Certification Program. The DHEC Environmental Laboratory Certification Program is regulated by EPA's National Environmental Laboratory Accreditation Program and certifies laboratories to follow EPA guidelines (Chapter 64E-1, F.A.C.).

Representativeness is the degree to which data accurately and precisely represent the characteristics of a population. Representativeness is insured through proper selection of sampling points. Tier 1 and 2 sampling sites have been selected for each 2-3 miles of beach based on beach access points, with additional sites in problem areas. Samples are taken at knee depth (approximately two feet) to best represent the area where recreation normally occurs. Tier 3 sites are selected based on use, accessibility, and hold time.

Completeness is the percentage of measurements that are considered valid and are entered into the data management system. A high percentage of completeness is achieved by controlling sample loss and data entry procedures. To control sample loss, samples are collected in plastic containers to control breakage. Each sample is given a unique identification number for tracking and will follow standard chain of custody procedures. Data is checked for completeness upon entry into the data management system. Any omissions are brought to the attention of the program coordinator and the applicable region manager.

Data sets are considered comparable when they can be considered equivalent with respect to the measurement of variables. Data sets are made comparable by uniformly training staff in sample collection and analysis. Collection of samples and analysis of water quality parameters follow approved methods and standard operating procedures.

### **Special Training Requirements**

The training of new staff will emphasize:

- the importance of following sampling SOPs;
- the theory behind indicator organisms;
- QA/QC protocols;
- how to complete DHEC Form 2508;
- how to use the data management systems;
- and the safety aspects of field sampling.

Current staff may not require additional training to follow the prescribed protocols. New DHEC employees who routinely perform field activities will receive basic training in accordance with the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (SC DHEC, 2001 Edition). All current DHEC field and laboratory staff are listed in the project organization chart.

### **Documentation and Records**

DHEC Central Office and region offices will retain appropriate documentation. The Ocean Water Quality Sampling Form (DHEC 2508, Appendix F) includes the following parameters.

- Project code and county location

- Sample dates, times, and station number
- Sample collector
- Sample identification numbers
- Weather conditions (clear, fair, cloud, rain)
- Rainfall in previous 24 hours
- Tidal condition (ebb or flood, 1/4, 1/2 or 3/4 ebb or flood)
- Current wind direction
- Salinity
- Enterolert results
- Chain of Custody
- Comments (may be used by sampler or lab analyst to document any difficulties or unusual circumstances)

Sample analysis will be performed solely by laboratories certified through DHEC's Office of Laboratory Certification. The Enterolert SOPs utilized by DHEC and the contract lab referencing Standard Methods 9223 are included in the attachments. Estimated lab turnaround time for bacteriological results is 24-28 hours. The Region Program Manager is notified immediately of any exceedances to the water quality standard for action as described in the sampling design in Appendix B. Timely enterococci results and notification is critical to the advisory notification program.

#### Data Reporting Package Format and Documentation Control

The format of all data reporting is consistent with the requirements and procedures for data validation and data assessment. All documents and records are handled according to the SOP developed by DHEC.

#### Data Reporting Package Archiving and Retrieval

All DHEC raw lab data, logbooks, analysis worksheets, analysis QC records, equipment QC records, etc. are maintained in the Region Offices for a minimum of three years before being transferred to the Central Lab for archiving of no less than twelve years. Data entered into the Environmental Facility Information System (EFIS) will be retained for the life of the system.

## **Measurement / Data Acquisition**

### **Sampling Process Design (Experimental Design)**

The standard operating procedures (SOPs) for field sampling describe the method by presenting the procedure in sequential steps and including specific facilities, equipment, materials and methods, and QA/QC procedures.

The proper collection, preservation, and storage of beach water samples is necessary to reduce errors in analysis. The sample container is an empty, sterile, disposable plastic sample container. The sample container is at least 125 milliliters (mL) in volume to allow for adequate sampling and good mixing. Sample containers larger than 1,000 mL are not used. Field sampling personnel do not open the sample container until just prior to taking the sample in order to protect the container from contamination.

Marine water samples are susceptible to rapid increases or death of microorganisms and hence are held for the shortest time possible to minimize change. Maximum holding time for bacteriological samples is six (6) hours. Steps for the preservation and transit of collected water samples will be followed precisely, or the sample will not be analyzed and another sample will be collected. Bacteriological samples must be iced or refrigerated at a temperature of 1-10 degrees Celsius (°C) and stored in insulated containers to assure proper maintenance of storage temperature during transit to the laboratory.

### **Rationale for the Design**

The protocol for sampling is outlined in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (SC DHEC, 2006 Edition), based on the grab sample technique.

### **Design Assumptions**

Tier I beaches are sampled weekly. Tier 2 beaches are sampled twice per month. One Tier 3 beach is sampled at this time. In order to allow time for the resampling, routine samples are collected Monday through Wednesday. The sampler will document any variations in sample collection site or protocol. Approximately 1,500 to 2,000 samples are collected and analyzed by DHEC per season, including repeat sampling.

### Procedures for Locating and Selecting Environmental Samples

DHEC has selected sampling sites, as described in the “Sampling Design and Monitoring Implementation Plan” (Appendix B), based on the criteria outlined in the “Risk-Based Beach Evaluation and Classification Plan” (Appendix A). Each site has been recorded with GPS units and mapped.

### **Sampling Methods Requirements – Tier I and II**

#### Equipment:

The following equipment and supplies will be used in sampling:

1. Disposable sterilized plastic sample bottles, 125 ml minimum capacity
2. Device for collecting sample in heavy surf
3. Polyethylene storage bags (if loose ice is used)
4. Coolers
5. Ice packs or loose ice
6. Permanent ink marking pens
7. Field log sheet, DHEC 2508

#### Step-by-Step Procedures

Samples are collected in disposable plastic sample bottles according to the following protocol.

1. Carefully check for and discard any sample bottle with cracked lids.
2. Label sample bottles and field log sheet (DHEC 2508, Appendix F) with station numbers of samples to be collected. Use a non-smearing permanent ink marking pen on sample bottles.
3. Identify the sampling site on the bottle label and on a field log sheet (DHEC 2508).
4. Remove the bottle lid just before obtaining each sample and protect bottle and lid from contamination. Be careful not to touch the inside of the bottle itself or the inside of the lid.
5. Wade into the surf or tidal area to a depth of approximately two feet (knee depth). In calm water, the sampler should strive to create as little disturbance of the area as possible. Allow time for sediment settling prior to collecting the sample. In unusually heavy surf, areas of exceptional currents, or dangerous or unknown bottom situations, sampling may

be conducted utilizing a reaching device, provided that the device does not allow for sample contamination.

6. Open a sampling bottle and grasp it at the base with one hand and plunge the bottle mouth downward into the water to avoid introducing surface scum. Position the mouth of the bottle into the current away from the hand of the sampler. Samples are taken six to twelve inches below the water's surface. If the waterbody is static, an artificial current can be created by moving the bottle horizontally with the direction of the bottle pointed away from the sampler. Tip the bottle slightly upward to allow air to exit and the bottle to fill.
7. Remove the bottle from the waterbody.
8. Pour out a small portion of the sample to allow an air space of approximately one inch above each sample for proper mixing of the sample before analysis. If present, use the 100 mL indicator line as a guide.
9. Replace bottle lid tightly.
10. Complete the field record portion of DHEC Form 2508 (Appendix F), to include, weather, tide, and current direction.
11. Store samples in a cooler with ice or ice packs while en route to the laboratory, maintaining a temperature of 1-10°C. If loose ice is used, bottles must be enclosed in sterile polyethylene sampling bags to prevent sample contamination. Do not hold samples more than 6 hours between collection and initiation of analysis.

### **Sampling Methods Requirements – Tier III**

Samples shall be collected from an area in the water body that is well mixed and is deep enough to submerge the sample bottle. The sample should be taken as close to the low tide point on the shore as possible while maintaining the safe operation of the boat. The sample bottle will be extended off the boat and submerged in the water collecting the sample. Wind direction, tidal stage, and weather condition will be determined *in situ* and recorded on DHEC forms 2508.



### Equipment:

The following equipment and supplies will be used in sampling:

1. Disposable sterilized plastic sample bottles, 125 ml minimum capacity
2. Device for collecting sample in heavy surf from a boat
3. Polyethylene storage bags (if loose ice is used)
4. Coolers
5. Ice packs or loose ice
6. Permanent ink marking pens
7. Field log sheet, DHEC 2508

### Step-by-Step Procedures

Samples are collected in disposable plastic sample bottles according to the following protocol.

1. Carefully check for and discard any sample bottle with cracked lids.
2. Label sample bottles and field log sheet (DHEC 2508, Appendix F) with station numbers of samples to be collected. Use a non-smearing permanent ink marking pen on sample bottles.
3. Identify the sampling site on the bottle label and on a field log sheet (DHEC 2508).
4. Remove the bottle lid just before obtaining each sample and protect bottle and lid from contamination. Be careful not to touch the inside of the bottle itself or the inside of the lid.
5. Extend the opened sample bottle into the water body as close to the shore line as possible. In calm water, the sampler should strive to create as little disturbance of the area as possible.
6. Samples are taken six to twelve inches below the water's surface. Tip the bottle slightly upward to allow air to exit and the bottle to fill.
7. Remove the bottle from the water body.
8. Pour out a small portion of the sample to allow an air space of approximately one inch above each sample for proper mixing of the sample before analysis. If present, use the 100 mL indicator line as a guide.
9. Replace bottle lid tightly.

10. Complete the field record portion of DHEC Form 2508 (Appendix F), to include, weather, tide, and current direction. Record an estimate of the distance to the shore line.
11. Store samples in a cooler with ice or ice packs while en route to the laboratory, maintaining a temperature of 1-10°C. If loose ice is used, bottles must be enclosed in sterile polyethylene sampling bags to prevent sample contamination. Do not hold samples more than 6 hours between collection and initiation of analysis.

## **Sample Handling and Custody Requirements**

### **Sample Custody Procedure**

Chain of Custody (COC) procedures from the EQC Environmental Investigations SOP and QA Manual are followed whenever samples are collected, transferred, stored, or analyzed. Samplers follow the sampling protocol and deliver samples to a certified laboratory for analysis. Laboratory staff will complete remaining portions of DHEC Form 2508 and any COC records required. Laboratory entries include: laboratory sample number, enterococci per 100 milliliters, salinity, date and time received, date and time analyzed, and date and time released. Each data report is initialed by the laboratory technician who reviewed the data.

The region program manager is responsible for overseeing any corrective actions involving sampling. If samples are not handled properly, they will not be analyzed and replacement samples will be collected promptly.

## **Analytical Methods Requirements**

All certified laboratories complete enterococci analysis using the Enterolert Quanti-Tray method as derived from Method 9223A,B of Standard Methods for the Examination of Water and Wastewater, 20th Edition. DHEC laboratories follow the procedure as outlined in the SC DHEC Laboratory Procedures Manual for Environmental Microbiology (Attachment 3). Estimated lab turnaround time for bacteriological results is 24-28 hours. The Region Program Manager is notified immediately of any exceedances to the water quality standard. Any problems or corrective actions involving the analytical methods used by the DHEC laboratories are addressed by the EQC Labs Office of Quality Assurance (OQA). The

laboratory is expected to document corrective actions by responding in writing (memorandum or email) to the OQA.

## **Quality Control Requirements**

### **QC Procedures**

Monitoring and laboratory staff will undergo all necessary training requirements. Region program managers will train and routinely monitor all DHEC field and laboratory staff for compliance with established protocols. Audits are conducted periodically by the program coordinator. SCDHEC Office of Quality Assurance will perform audits on the laboratories at a minimum of every 2 years. These audits serve also as Laboratory Certification Audits. Sample handling and custody requirements will be monitored after each sample is collected and during the transfer of the samples to the laboratories. Data is double-checked upon entry and is reviewed by the program coordinator. Current QC protocols used by the DHEC laboratories and the municipal contract laboratory are attached.

## **Instrument/Equipment Testing, Inspection, and Maintenance**

All testing, inspection, and maintenance of laboratory equipment are conducted as prescribed by laboratory QA manuals. Please reference attachments for DHEC and contract laboratory procedures.

## **Instrument Calibration and Frequency**

All laboratory instrument calibration is conducted as prescribed by laboratory QA manuals. Please reference attachments for DHEC and contract laboratory procedures.

## **Inspection/Acceptance Requirements for Supplies**

### **Critical Supplies**

The necessary supplies for field sampling include sterile polyethylene sampling bags, sterile disposable plastic sample containers with labels, insulated containers for transporting samples, ice packs or loose ice, ocean water quality sampling forms, and sampling SOPs/checklists. The DHEC Program Manager and Laboratory Manager are responsible for

ensuring the necessary field and lab supplies are available as needed. The municipal contract lab has designated similar responsibilities in their QAPP.

#### Inspection Requirements and Procedures

DHEC's Division of Laboratory Services establishes criteria for inspecting and accepting laboratory supplies. Other certified laboratories will establish criteria based on DHEC Laboratory Certification requirements.

#### **Data Acquisition Requirements**

Discussed in the section titled Data Quality Objectives and Criteria for Measurement Data.

#### **Data Management**

##### Data Recording

The DHEC Lab utilizes a Laboratory Information Management System (LIMS) to verify and store data. Once samples have been collected and analyzed, the results are entered into LIMS and subsequently uploaded to the Environmental Facility Information System (EFIS) database. Region staff and the beach monitoring coordinator assess the data for completeness and data entry errors. Any discrepancies are verified with the hard copy and region staff. The nature of the data and the subsequent analyses will be consistent to permit the comparison of data in one set to others. Hard copies of field and laboratory data will be stored for no less than twelve years. Electronic data will be stored for the life of the system.

##### Data Validation Checklist

Data will be validated and verified based on an assessment of the following factors:

1. Completeness of the data;
2. Adherence to proper sample preservation, transport, or handling protocols;
3. Proper use of sample collection procedures;
4. Proper use of quality control criteria;
5. Documentation of all data;
6. Ability to reconstruct all field sampling procedures through documentation and records of such procedures;

7. Ability to trace data in the final report to a specific sampling site, date, and time;
8. Appropriateness of the data as related to specific data quality objectives.

## **Assessment / Oversight**

### **Assessments and Response Actions**

#### Assessment Activities and Project Planning

DHEC reviews data for discrepancies and missing information following each sampling period. The status of the project will be evaluated through this surveillance of the records and will ensure that the requirements of the QAPP are being fulfilled. Periodic audits, a minimum of one per season, of field sampling techniques will be conducted by the region program manager and the program coordinator to ensure that protocols are consistent with the QAPP. The DHEC Office of Quality Assurance conducts annual internal assessments of the region laboratories. DHEC's Office of Laboratory Certification will perform contract laboratory assessment activities, such as annual proficiency testing samples, where applicable. There will be continual review of monitoring and notification documentation.

#### Documentation of Assessments

Surveillance of data quality will be conducted throughout the project. The Office of Laboratory Certification or the Office of Quality Assurance will correct any problems encountered with region or private certified laboratories.

### **Reports to Management**

The frequency, content, and distribution of reports will be submitted as described in the section titled Documentation and Records of the QAPP and in "Reports to EPA" (Appendix C). The responsible organizations are described in Section A4 of this QAPP. QA reports from internal assessments of the region labs are reported directly to management. The DHEC Office of Quality Assurance will work with management to address any significant QA problems identified.

## **Data Validation and Usability**

### **Data Review, Validation, and Verification**

### Sampling Design

The “Sampling Design and Monitoring Implementation Plan” (Appendix B) describes sample site selection and the frequency of sampling.

### Sample Collection Procedures

If the sampler is unable to sample according to the protocol (Section B), then the samples will not be analyzed and resampling will occur.

### Sample Handling

Certified laboratory staff routinely check storage containers to ensure that samples are transported and stored under conditions that do not adversely affect the quality of the sample. COC requirements will be conducted as described in the section titled Sample Handling and Custody Requirements and in the EQC Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. If samples are not handled properly, they will not be analyzed and replacement samples will be collected promptly.

### Analytical Procedures

Certified laboratories have the instrumentation, techniques, and qualified staff to perform the analyses. Laboratory SOPs related to COC, instrumentation, and technique have been developed as part of the EQC SOP Manual, the Laboratory Procedures Manual and Laboratory Certification requirements. Laboratory personnel will follow the Enterolert Quanti-Tray Method for the detection of enterococci based on Standard Method 9223A,B. DHEC laboratory personnel will follow the procedure as outlined in the SC DHEC Laboratory Procedures Manual for Environmental Microbiology based on Standard Method 9223A,B (Attachment 3).

### Quality Control

Sampling quality control will be carried out as discussed in the section titled Quality Control Requirements. Laboratory quality control activities will be conducted according to DHEC’s laboratory QA manual.

### Calibration

Instrument calibration activities are performed following DHEC’s laboratory QA manual.

### Data Reduction and Processing

A loss of detail in data will be avoided by the review of data entry and by following the laboratory's QA manual for data reduction and processing activities.

### **Validation and Verification Methods**

Laboratory managers in each DHEC laboratory enter, validate, and verify all analytical data released by their labs. Data entered into the LIMS is verified by the Data Management Section of the Central Laboratory. Program managers review and validate sample collection information. Decisions on rejection of data would be based on assessment of data validation criteria as outlined in the section titled Data Management. A joint decision between the beach monitoring coordinator, region program manager, and lab manager would resolve any data use issues.

### **Reconciliation with Data Quality Objectives**

This program is designed to support intended use of results through the collection of water quality data.

## **References**

USEPA, 1986. Ambient Water Quality Criteria for Bacteria-1986. U.S. Environmental Protection Agency. EPA-440/5-84-002.

SC DHEC EQC Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, 2006 Edition, Revised 2008.

SC DHEC Laboratory Procedures Manual for Environmental Microbiology, Analytical Services Division, Office of EQC, Bureau of Environmental Services, January 1, 1998, Revised 2001.



## **APPENDIX A**

### **Risk-Based Beach Evaluation and Classification Plan**

The goal of this process is to identify coastal recreation waters, including waters adjacent to beaches or similar points of access that are used by the public and to rank these beaches based on beach use and the potential risk to human health presented by pathogens. This ranking system will be used to prioritize monitoring efforts under the Beaches Environmental Assessment and Coastal Health (BEACH) Act.

#### **Step 1. Identify Coastal Recreation Waters**

The BEACH Act defines coastal recreation waters as “...marine coastal waters (including coastal estuaries) designated under the Clean Water Act (CWA) section 303 (c) by a state for use for swimming, bathing, surfing, or similar water contact activities...do not include either inland waters or waters upstream of the mouth of a river or stream that has an unimpaired natural connection with the open sea.” All tidal saltwaters within South Carolina are classified as suitable for primary and secondary contact recreation. Also, due to the configuration of South Carolina’s coastline and extensive estuarine system, it is difficult to appropriately define all waters that meet the BEACH Act definition. Therefore, coastal recreational waters for the BEACH program have been determined as all waters seaward of the Coastal Critical Line, as defined in the South Carolina Code of Regulations, Chapter 30-10. This line was determined through the use of biological field surveys and aerial photography and is based on vegetation changes (from predominately brackish to predominately fresh) at the uppermost point of estuarine systems. An approximate description of this boundary is as follows: On the south at the intersection of the South Carolina-Georgia border and the old track bed of the Seaboard Coastline (SCL), approximately 1.75 miles above the U.S. Highway 17-A bridge across the Savannah River; thence, northeastward along the track bed until its intersection with S. C. 462 near Euhaw Creek; thence, northward along S. C. 462 until its intersection with U.S. Highway 17/U.S. Interstate 95 near Coosawhatchie; thence, northeastward along U.S. 17/U.S. Interstate 95 until U.S. Highway 17 and U.S. Interstate 95 intersect at Point South, thence, northeastward along U.S. 17 until its intersection with S-15-26, approximately two miles east of Green Pond; thence, southward along S-15-26 (Bennetts Point Road) until its intersection with the old SCL track bed near Airy Hall; thence, east-northeastward along the track bed on its intersection with

S. C. 174; thence, northward along S. C. 174 for approximately 1.5 miles until its intersection with S. C. 164; thence, east-northeastward approximately three miles along S. C. 164 until its intersection with S. C. 165; thence, northward along S. C. 165 (Bacons Bridge Road) until its intersection with S. C. 642 (Dorchester Road); thence, southeastward along S. C. 642 until its intersection with U.S. Interstate 26; thence, southward along I-26 until its intersection with S. C. 7 (Cosgrove Avenue); thence, northeastward on S. C. 7 until its intersection with the SCL track bed adjacent to S-10-32 (Spruill Avenue); thence, northward along this track bed until its intersection with the Charleston County/Berkeley County line, approximately one-fifth mile north of S-10-13 (Remount Road); thence, east-northeastward along the county line until its intersection with the Cooper River at Goose Creek; thence, eastward by a straight line across the Cooper River and mouth of Yellow House Creek to Jessen Road at the Cainhoy Industrial Park, thence southeastward until its intersection with (Clements Ferry Road); thence, northeastward along S-8-33 until its intersection with S-8-100 (Resurrection Road) until its intersection with S. C. 41, thence northeastward on S-8-100 (Halfway Creek Road); thence, northeastward along S-8-100 until its intersection with S-10-98 (Guerins Creek Bridge Road); thence, southward along S-10-98 until its intersection with U.S. Highway 17; thence, northeastward along U.S. Highway 17 until its intersection with S-27-30 north of the North Santee River; thence, eastward along S-27-30 for approximately five miles; thence, northward along S-27-30 until its intersection with S-27-18; thence, northwestward along S-27-18 until its intersection with U.S. Highway 17 south of Georgetown, thence northeastward along U.S. Highway 17 (Frasier Street) through Georgetown, thence northeastward along U. S. Highway 17 until the intersection of U.S. Highway 17 Business and U.S. Highway 17 Bypass south of Murrells Inlet; thence, northeastward along U.S. Highway 17 Business (Kings Highway) through Murrells Inlet, Garden City, Surfside Beach, and Myrtle Beach until its intersection U.S. Highway 17 north of Myrtle Beach; thence northeastward along U.S. Highway 17 until its intersection with the South Carolina-North Carolina border. In determining the exact location of this boundary, only those lands seaward of the right-of-way line located on the upstream side of road beds and track beds described shall be included in the tidelands and coastal waters critical areas. The coastal critical line is indicated by the heavy black line on the enclosed maps.

## **Step 2. Identify Bathing Beaches and Similar Points of Access**

Bathing beaches and public access points adjacent to coastal recreation waters were identified using several resources. Traditional beaches, such as those on the Atlantic Ocean shoreline and barrier islands were determined using previous beach monitoring information, maps of the coastal area, and literature from DHEC's Office of Coastal Resource Management (OCRM). Inland beach areas, such as those in bays and estuaries were based on previous beach monitoring sites and lists generated by the Environmental Quality Control office staff in each coastal region.

Other points of access within the coastal recreational waters were determined using GIS coverage of OCRM's records of critical area permitting from 1980 - 1988 and 1992 - 2002 (1989-1991 locational data was not available). All community boat docks, public jet ski ramps, public boat ramps, and public piers within the critical area are included as points of access. All marinas within the critical area are also included as public access points. A list of bathing beaches and similar points of access are included as Attachment 1. Maps of these sites are also included.

## **Step 3. Review Available Information**

In order to establish ranking of identified beaches and points of public access, DHEC reviewed available information concerning intensity of beach use, potential risk to public health, and other applicable factors.

### **Intensity of Beach Use**

Intensity of beach use was based on accessibility of the beach, available governmental data, and observations of actual use. Accessibility encompassed factors such as public or private beach, number of access points, amount of available parking, and if accessible by foot or by boat only. Information concerning access was gathered from the South Carolina Department of Natural Resources and SC DHEC's Department of Ocean and Coastal Resource Management. Coastal governments' tourism and chamber of commerce websites were accessed for additional information concerning use. The 2000 Census and the South Carolina Statistical Abstract 2001-2002 (SC Budget and Control Board) were also examined for data concerning each coastal county. Input concerning actual use was gathered from sample collectors, region program managers, and shellfish sanitation managers and patrolmen. Input was also gathered from

government staff and the public at informational meetings held in each coastal region (Appendix G).

#### Potential Risk to Public Health

For those beaches previously monitored, risk was assessed based on the presence of known pollution sources and the number of advisories and total beach-mile-days of advisories in the 2002 swim season. For those beaches and points of access not previously monitored, risk was inferred based on several factors. These factors included water body classification, potential for point and non-point source pollution, historic water quality of similar areas, type of use (likelihood of ingesting water), and susceptibility of user population.

#### Other Factors

Other factors considered in establishing beach priorities were the importance to the local economy and tourism industry, public opinion, and public input. South Carolina's Atlantic Ocean coastline is a well-known feature of the State drawing millions of visitors annually and boosting local economy. Protecting public health through monitoring of this area is a public expectation as can be seen through the abundance of news articles and environmental group publications. Due to these factors, oceanfront beaches are given priority in the ranking scheme.

#### **Step 4. Rank Beaches**

The risk-based beach evaluation and classification process culminates in the ranking of bathing beaches to be monitored under the BEACH program. This ranking is based on the potential health risk, usage, and other factors previously discussed. Input on ranking was also gathered at public meetings held in each coastal region. A three tier system was used for this process, with Tier 1 being the highest priority. Tier rankings for each beach are given in Attachment 1.

## **APPENDIX B**

### **Sampling Design and Monitoring Implementation Plan**

The objective of South Carolina's beach monitoring program is to protect public health through the issuance of advisories based on accurate, representative sampling. This sampling design and monitoring implementation plan has been developed to describe the frequency and location of monitoring and assessment of South Carolina's coastal recreation waters.

A study to determine levels of bacteria in the surf of South Carolina beaches under varying site and environmental conditions was conducted with ten local governments in 1997. One sampling site was selected for each two to three miles of beach, and one each at the furthest reaches of accessible beach within each participant's jurisdiction. In areas with swashes or storm water discharges to the beach, sites at their confluence with the ocean, and 100 feet on either side, were selected. At a minimum, the two sites with the highest estimated storm flows in each municipality or jurisdiction were included. Samples were collected in dry weather at high and low tide and in wet weather at high and low tide. "Dry" weather meant that three or more days had passed since the last rain. "Wet" weather samples were collected within three hours of the first rain of 0.1 inches or more, following a dry period. Over 1,400 surf and storm water samples were collected during this study. Major finding of the study were:

- In areas with no storm water outlets or swashes, the geometric mean did not exceed 35 /100mL and all individual sample results were less than 104/100mL regardless of weather conditions.
- Beaches with discharges from swashes and/or storm water outlets showed variability based on weather. Dry weather samples from these areas did not exceed the EPA recommended geometric mean (35/100mL). Wet weather effects on surf bacteria varied from site to site and with rainfall amount; results from many samples exceeded the single-sample limit. In general, highest single-sample densities were associated with rainfall amounts greater than one inch.

Routine monitoring of beaches from 1998 through present has validated the previous points and has added to our understanding of beachfront water quality dynamics. This

monitoring has shown that beaches with associated storm water runoff (Tier 1 beaches) have the highest counts in the period three hours before to three hours following ebb tides. Based on the 1997 study and on subsequent routine monitoring efforts, the following monitoring plan has been developed.

### Sampling Design

		Tier 1	Tier 2	Tier 3
A. When to Conduct Basic Sampling		April 15 - October 15  Once per week  Three hours before to three hours after low tide	April 15 - October 15  Twice per month  Random tidal stages	April 15 – October 15  Once monthly*  Random tidal stages
B. When to Conduct Additional Sampling				
	After a water quality standard is exceeded	If any sample exceeds the action level a repeat sample will be taken within 24 hours of result notification.		
	After a sewage spill or pollution event	Sampling will be conducted as soon as possible following a sewage spill or other pollution event. At region manager's discretion, beaches will be preemptively closed until satisfactory sample results are received.		
	Reopening after advisory or closure	Additional samples shall be taken following an advisory until sample results fall below the action level and advisory is lifted.		

Note: Basic sampling begins April 15<sup>th</sup> of each year. However, due to very limited public contact with the water, repeat and rainfall sampling will not begin until the official season start, May 15<sup>th</sup>. This design follows EPA's recommendation of beginning sampling one month prior to the season start.

\* If funding is available.

In 2006 a rain model was developed based on previous sampling data and used as an advisory prediction tool in the 2007 season. For the 2008 season, the following plan will be used.

## Sampling Design

		Tier 1	Tier 2	Tier 3
A. When to Conduct Basic Sampling		April 15 - October 15 Once per week Random tidal stages	April 15 - October 15 Twice per month Random tidal stages	April 15 – October 15 Once monthly Random tidal stages
B. When to Conduct Additional Sampling				
	After a water quality standard is exceeded	If any sample exceeds the action level a repeat sample will be taken within 24 hours of result notification.		
	After a sewage spill or pollution event	Sampling will be conducted as soon as possible following a sewage spill or other pollution event. At region manager's discretion, beaches will be preemptively closed until satisfactory sample results are received.		
	Reopening after advisory or closure	Additional samples shall be taken following an advisory until sample results fall below the action level and advisory is lifted.		

## Where to Conduct Sampling

### Tier 1 and 2

Samples will be collected at sites selected during previous years' monitoring efforts. Sampling sites are located every two to three miles along the beachfront based on public access points. Additional sites are located near problem areas such as swashes and storm drain outfalls. Each site has been recorded with global positioning systems (GPS) technology and mapped. Samples are collected at knee depth (approximately two feet) to best represent the area where recreation normally occurs. See Attachment 1 and enclosed maps for sample locations.

### Tier 3

Sampling sites at Tier 3 coastal beaches will begin in 2008 with selected beaches. Sites will be chosen based on location of access points and observation of areas of public congregation. They will be sampled once per month from a boat. These sites will be recorded with GPS technology in the future. See Attachment 1 and enclosed maps for access point locations. Sample depth will be the same as Tier 1 and 2 beaches.

## **APPENDIX C**

### **SC DHEC's Reports to EPA**

The goal of this product is to describe the mechanism for the South Carolina Department of Health and Environmental Control (DHEC) to collect relevant information and submit timely reports to the United States Environmental Protection Agency (EPA). All advisories are issued and retracted by DHEC. Advisory signs are posted and removed by DHEC staff or the municipality, as directed by DHEC. .

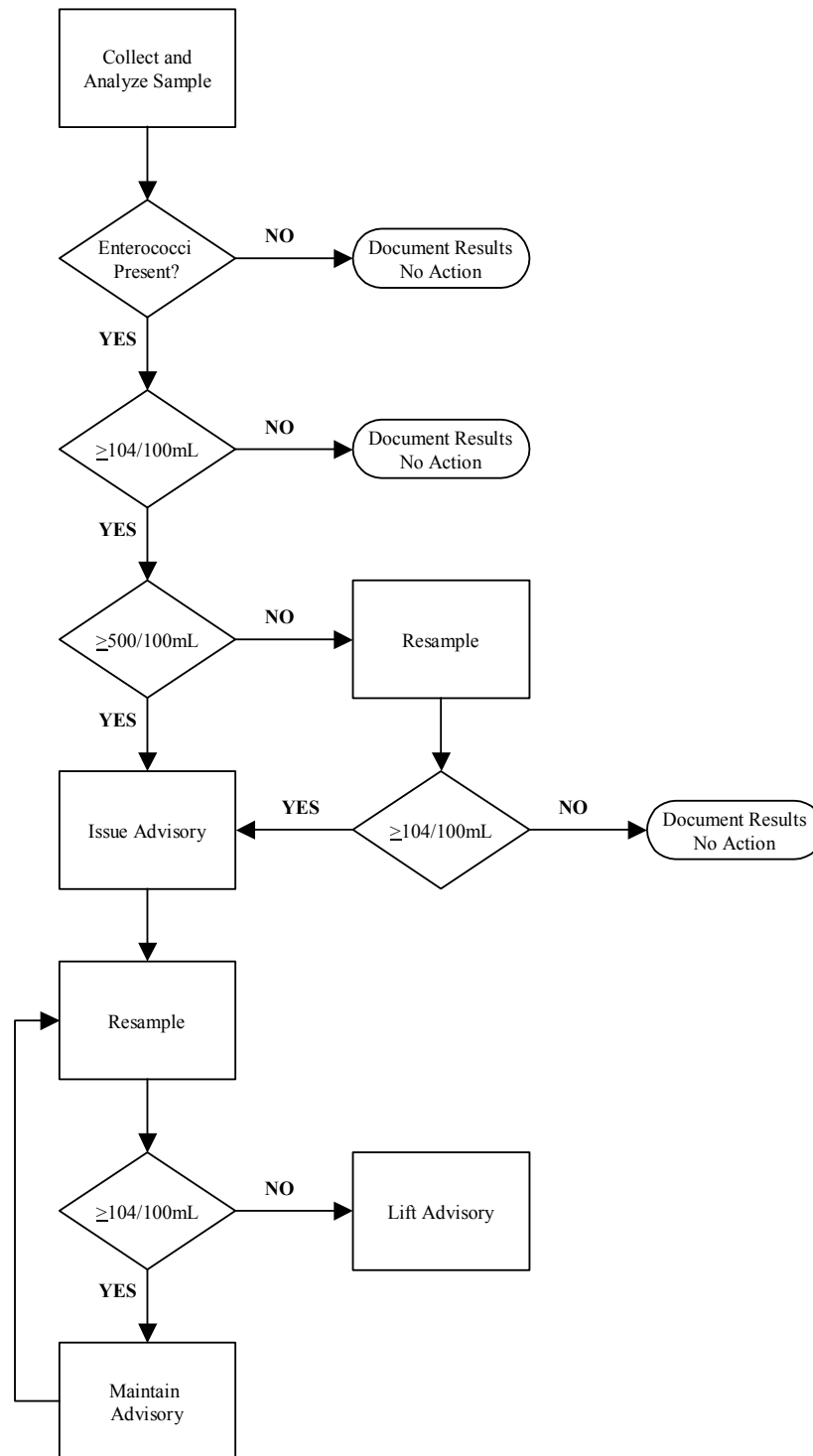
#### **SC DHEC Submittal of Results and Advisories to EPA**

All data for the beach monitoring program will be maintained in DHEC's Environmental Facility Information System (EFIS). EFIS is an Oracle based enterprise-wide, client-server information system. Data entry fields will be designed according to EPA specifications. DHEC will make data meeting the XML schema requirements available on a Network Node for upload or retrieval by EPA. From this data, EPA will be able to annually retrieve all needed information such as; number of times criteria were exceeded, the number of days each beach was under advisory, and the number of beaches for which advisories were issued. DHEC will promptly report advisories to the designated EPA contacts via electronic mail or telephone, as requested.

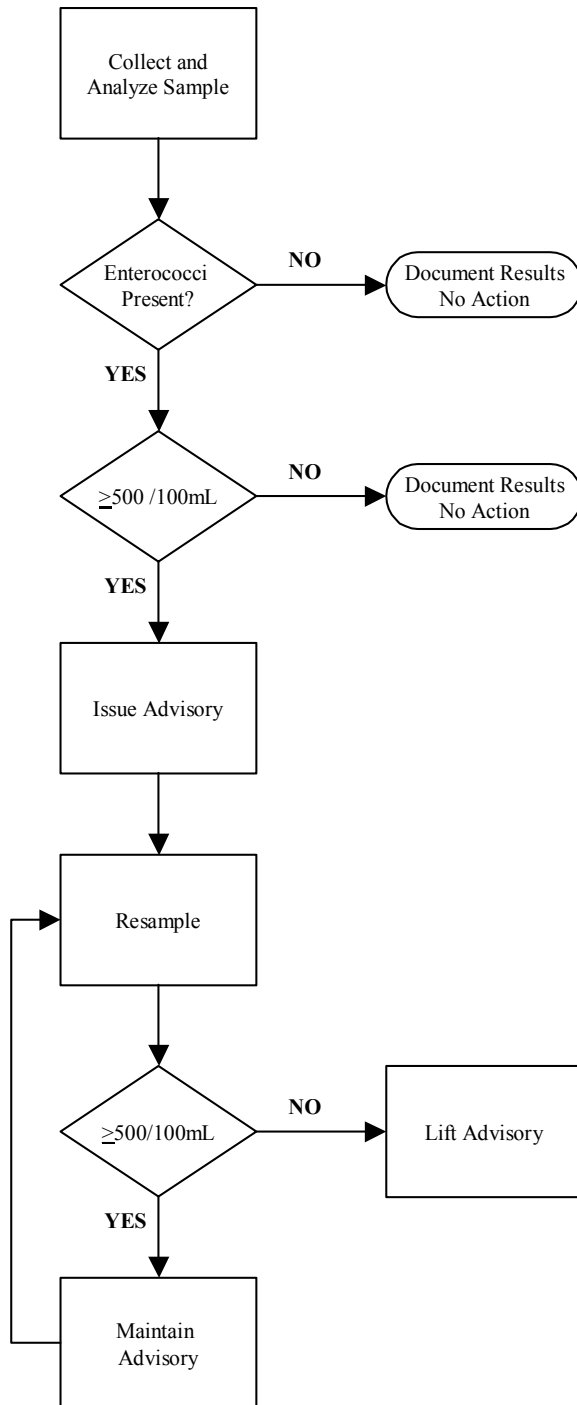


## APPENDIX D

### Decision Flow Chart – Tier 1 and 2 Beaches



## Decision Flow Chart – Tier 3 Beaches



## **APPENDIX E**

### **Overall Notification and Risk Communication Plan**

This overall public notification and risk communication plan describes the methods that the South Carolina Department of Health and Environmental Control (DHEC) shall employ to communicate to the public when enterococci levels exceed acceptable limits and water contact activities in coastal waters may pose a risk to public health. This plan identifies the measures for prompt communication of such exceedances and identifies how the information will be communicated to EPA, local government officials, and the public.

### **Problem Assessment and Audience Identification**

South Carolina's bathing beaches are important components of the state's tourism industry. DHEC regularly monitors coastal beaches for the bacterial indicator enterococci to assure residents and tourists that the water is safe for water contact activities. The goal of this program is to allow the public to make informed decisions concerning recreating in waters presenting a health risk.

Bacterial indicator results that exceed action limits will require that the responsible party either immediately resample the water body in question to confirm these conditions or issue a beach advisory. When an advisory is issued for a beach, DHEC must disseminate the information to a population that consists of local governments, tourists, and residents. The public is alerted to an advisory or warning through beach sign postings, local press releases, and the Internet. Interested persons may also call the local district office or the central office for listings and updates on advisories.

### **Types of Advisories and Notification Plan**

South Carolina issues water quality exceedance advisories. Permanent precautionary warnings are also issued for specific areas.

#### **Water Quality Exceedance Advisory**

If a routine sample at a Tier 1 or 2 beach exceeds 104/100 mL, a repeat sample is collected within 24 hours. If the repeat sample also exceeds 104/100 mL, an advisory is issued. If any single routine sample exceeds 500/100 mL (Tier 1, 2, or 3), an advisory is immediately issued.

### Permanent Precautionary Warnings

Permanent precautionary warnings are issued at specific swashes and storm water outfalls based on continuous poor water quality in these areas, especially following rainfall. Permanent signs are posted at these sites warning that swimming or playing in runoff is not recommended. This general warning is also included in water quality advisories for affected beaches and in the beach description on the Earth 911 website.

### Procedure for Issuing Advisories

In the event of an advisory, the responsible region staff member contacts the appropriate municipality. DHEC or the municipality post signs at conspicuous areas on the affected beach. Beach advisory signs include a statement that explains that swimming is not advised due to high bacteria levels in the water, but that wading, fishing, and shell collecting do not pose a risk and list contact information (see Attachment 2). Local media outlets are contacted by the region program manager or the municipality, as previously negotiated. A copy of the advisory is sent by electronic mail to the program coordinator and each coastal region office (Region 6 - Waccamaw, Region 8 - Low Country, Region 7 - Trident). The advisory includes as a minimum:

- date issued
- the location of the advisory ex: 200 feet above and below 16<sup>th</sup> Avenue North
- percentage of the total beach affected by this advisory
- reason for the advisory (if known) ex: heavy rainfall or sewer line break
- text of the advisory: A Swimming Advisory Has Been Issued By (local jurisdiction) and The SC Department of Health and Environmental Control for This Section of Beach. High Bacteria Levels Have Been Detected In This Section of The Beach, and Swimming Is NOT Advised Until Bacteria Levels Return to Normal
- district contact number

DHEC also maintains a web site that is useful for communicating information to residents, tourists and other agencies. This website contains program information, frequently asked questions, and program contact information ([www.scdhec.gov/beach](http://www.scdhec.gov/beach)). The web site also features a link to the Earth 911 Beach Water Quality website. The Earth 911 website ([www.earth911.org](http://www.earth911.org)) is updated by DHEC region staff upon receipt of water quality results.

Sample sites under advisement show up as red on the website, areas not under advisement are green. The website also offers a printable beach status report.

#### **Procedure for Removing Advisories or Warnings**

An advisory is removed when sample results confirm that enterococci levels are within acceptable limits (<104/100mL for Tier 1 and 2, <500/100mL for Tier 3). The municipality is notified of the sample results, the website is updated by DHEC staff, the signs are removed, and media outlets are contacted by DHEC region staff.

#### **Evaluation of the Notification Program's Effectiveness**

The notification program will be continuously evaluated to ensure that the needs of the public and the objectives of DHEC are fulfilled. Members of the community may visit the DHEC beach monitoring website and send electronic mail with comments and suggestions or contact the central office or local district office. Periodic meetings with the coastal region office staff will be used to evaluate implementation of this plan and refine it as necessary.

## APPENDIX F

[illegible]



# NEWS RELEASE

Division of Media Relations  
2600 Bull Street  
Columbia, S.C. 29201  
(803) 898-3886  
[www.scdhec.gov/news](http://www.scdhec.gov/news)

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## APPENDIX G

### Public Evaluation of Program

At the beginning of each beach season, DHEC's Office of Media Relations sends out a news release asking the public for input to the program. This news release is shown below.

#### **FOR IMMEDIATE RELEASE**

April 2, 2008

#### **BEACH grant comments sought**

COLUMBIA – South Carolinians are encouraged to comment on beach monitoring and public notification under the federal Beaches Environmental Assessment and Coastal Health Act, the state Department of Health and Environmental Control reported today.

"The BEACH Act authorizes the U.S. Environmental Protection Agency to award grants to states, tribes and territories to implement beach water quality monitoring programs at coastal and Great Lakes recreational beaches," said Shannon Berry, beach monitoring coordinator in DHEC's Bureau of Water. "These grants also support programs to inform the public about the risk of exposure to disease-causing microorganisms in the waters at beaches. South Carolina is one of 35 states receiving the EPA grant."

Berry said DHEC monitors the quality of water at the state's beaches every year.

"When bacteria levels in the water are too high, the public is notified of beach warnings or closings when necessary," Berry said.

Berry said comments are being sought on the following components of the beach monitoring and public notification program:

- Beach evaluation and classification process, including a list of waters to be monitored and beach ranking.
- Sampling design and monitoring plan, including sampling location and frequency.
- Public notification and risk communication plan, including methods to notify the public of swimming advisory.

For additional information contact Shannon Berry at (803) 898-3541 or at [berrysk@dhec.sc.gov](mailto:berrysk@dhec.sc.gov).

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**For more information:**

Thom Berry – (803) 898-3885

E-mail – [berrytw@dhec.sc.gov](mailto:berrytw@dhec.sc.gov)

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